



Airline and National Strategies for Dealing with Airport and Airspace Congestion

Michael O. Ball

University of Maryland

Geoff Gosling

University of California, Berkeley

Amedeo Odoni

MIT



Background

- Workshop held at University of Maryland, March 15, 16 2001
- Organizers: M. Ball and A. Odoni
- Sponsored by:
 - NEXTOR, the National Center of Excellence for Aviation Operations Research,
 - The Global Airline Industry Center at MIT (sponsored by the Sloan Foundation)
 - R H Smith School of Business at the University of Maryland
- ~100 Participants from Academia, Government and Industry



Workshop Topics

- Causes and Nature of Delay
- Prospects for Growth in System Capacity
- Air Traffic Flow Management
- Demand Management
- Airline Business Strategies
- National and International Policy Alternatives



Nature of Delay: flight delay vs passenger delay [Barnhart & Bratu]

On-time delay statistics collected by DOT (% of flight > 15 minutes late) have remained almost constant between 1995 and 2000, yet the number of passengers whose travel was seriously disrupted has clearly increased – how can this be possible??

- Increase in num of flights w very long delays
- Increase in num of flight cancellations
- Increase in ave load factors on flights



Cost of Delay and Lost Throughput [Kostiuk]

Direct cost of 1999 delays: \$2.2 B addition fuel and crew operating costs

+ Associated passenger delay cost > \$5 B

10 Year Projections: annual airline revenue will be \$9 billion (if aircraft size increased) to \$19 billion (if current average aircraft size is maintained) lower than the revenues that unconstrained demand would otherwise support.



Initiatives or Activities That Can Reduce Delays

1. Capacity growth through additional airports and runways and through an improved air traffic management (ATM) system.
2. Better “real time” air traffic flow management (TFM) at both the strategic and tactical levels.
3. Demand management at the busiest airports.
4. Airline operational and business strategies aimed at reducing the impact of congestion on airline schedules and costs.



Prospects for Increasing Capacity

Clearly the number of airports and runways is a major system bottleneck – prospects for building more, particularly in areas where they are most needed, is not good:

- Already crowded urban areas
- Local opposition fueled by environmental and quality-of-life concerns

Other on-going initiatives: Free flight phase I & II; ADSB and GPS approach procedures: consensus range for capacity increase: 5 – 20% increase, over 15 years [Hansman].

More complete free flight with reduced aircraft separation and transfer of much control and decision-making to aircraft -- when, how much impact on capacity??



Improved Traffic Flow Management (TFM): Getting More Out of Existing Capacity

Case studies point to instances when capacity significantly underutilized because of lack of coordination and accurate information → improved TFM may be able to produce substantial increases in throughput [Clarke & Evans].

Recent initiatives at Air Traffic Control System Command Center (ATCSCC) [Kies]:

- Strategic planning team
- National playbook
- Coded departure routes
- Collaborative Convective Forecast Product
- LAADR: Low Altitude Arrival and Departure Routes



Collaborative Decision Making [Ball]

- **Recent Accomplishments:**
 - Initial application area: Ground Delay Programs
 - CDMnet interconnects FAA TFM facilities and airline operational control centers → improved information and common situational awareness
 - New allocation principles and Dec Support Tool FSM: collaboration in determination of delay allocation → airlines have control over economic tradeoffs.
- **Provides framework and philosophical basis for broad application in TFM**
 - Improved overall resource utilization
 - Greater equity
 - Improved economic performance by user groups, e.g. airlines



Demand Management: Motivation

... regulations or actions aimed at reducing the number of aircraft requesting access to a busy airfield (or portion of airspace) and/or at modifying the temporal characteristics of such demand

Interest stimulated by LaGuardia situation where demand saturation led to use of lottery to allocation slots

- for good weather days, 10% reduction in demand led to 80% reduction in overall delay minutes [Odoni & Fan]

Issue: *external costs* (or “marginal delay costs”) imposed on other flights by aircraft operated at busy airports can be very large, e.g. at LGA and BOS, external costs can exceed landing fees factor of 10 or more [Odoni & Fan]

- if the size of the aircraft is taken into account, the delays imposed on other flights by small aircraft can greatly exceed any possible benefit to the passengers on those flights [Hansen & Gosling]



Demand Management: Implementation Issues

- Who should take the initiative in this area?
- Should there be blanket policies or case-by-case applications?
- Who charges?
- What is done with money?
- What is impact on competition?
- What is impact on regional access to major airports?
- Are there conflicts with existing airport use and multi-lateral international aviation agreements?



Airline Strategies

Move to hub-and-spoke systems and regional jets (RJs) [Hansman], [Chew], [Hauenstein]

Criticisms: hub-and-spoke system is more brittle leads to compounding of delays; RJs don't make most efficient use of landing time slots

Response: Hub-and-spoke and RJs together have led to much better service to smaller markets – these developments are response to marketplace; change is difficult since this is direction of marketplace push



Airline Response to Delays

- Airline strategies [McDonald]:
 - Better passenger information
 - More robust schedules
 - More spare aircraft
- CDM has led to improved airline performance during congested periods [Beatty]
- Airlines need to focus more on, and invest in, the operational control side of their business [Wambsganss]



Areas of Research Need (that are not now receiving much priority)

- Aviation Delay Modeling and Analysis
- Market Mechanisms for Aviation Resource Allocation
- Traffic Flow Management and System Capacity
- Weather and Decision Making
- Aeronautical Communications



Aviation Delay Modeling and Analysis

- Relationship between flight delay and passenger delay
- New metrics that are more reflective of passenger delay
- Relationship among national policies, airline strategies and delay/throughput



Market Mechanisms for Aviation Resource Allocation

- Benefits of demand management, incl tradeoffs between capacity expansion and demand management
- Development of market mechanisms for aviation:
 - Who implements?
 - What is done with (any) revenues?
 - What is impact?
 - What regulations, policies are required?
 - What can be learned from other industry experience?



Traffic Flow Management and System Capacity

- What is system “capacity” today?
... what are true “physical barriers” and how much improved performance can be obtained from better TFM??
- Performance measurement and congestion prediction
- Uncertainty modeling and system control strategies based on stochastic information and models
- Collaborative Decision Making and distributed control



Weather and Decision Making

- Development of weather products that are compatible with decision requirements and decision models
- Development of decision models that are compatible with weather products
- Integrated weather models, operational concepts, decision models



Aeronautical Communications

- Understanding of long-term aviation spectrum requirements vs potential spectrum available
- Aeronautical communications based on next generation satellite systems
- Use of dedicated vs commercial communications systems
- Special purpose protocols (e.g ATN) vs general purpose protocols (e.g. IP)